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IDENTIFIER:
TITLE: ALUMINUM NITRIDE CERAMICS ELECTRODE BUILT-IN
MEMBER

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ABSTRACT:

PROBLEM TO BE SOLVED: To improve durability of a ceramics electrode built-in member used for a semiconductor manufacturing apparatus, a liquid crystal manufacturing apparatus and so on, and specifically to provide an aluminum nitride ceramics electrode built-in member used for a heater which can uniformly heat a wafer, a liquid crystal display substrate and so on by electric heating, an electrostatic chuck which can fix an object by an uniform electrostatic attraction, or a high frequency power applying susceptor which can apply uniform high frequency power.

SOLUTION: This member has a built-in metal electrode of which the cross- section aspect ratio is 2-8, and an aluminum nitride ceramics electrode is used as the built-in metal electrode.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] About the member with a built-in electrode made from the alumimium nitride ceramics used for semiconductor fabrication machines and equipment or a liquid crystal manufacturing installation, this invention is loaded more into a detail by semiconductor fabrication machines and equipment or the liquid crystal manufacturing installation, and relates to members with a built-in electrode made from the alumimium nitride ceramics, such as a heater used for processing of a wafer, a liquid crystal display substrate, etc., an electrostatic chuck, and a susceptor for RF impression.

[0002]

[Description of the Prior Art] In semiconductor fabrication machines and equipment, when performing processing processing of plasma etching, CVD, ion plating, etc. to a wafer etc., the field-like heater is used as a member which heats a wafer. Moreover, as a holddown member of a wafer, the electrostatic chuck and the susceptor for RF impression are used abundantly. Moreover, the same member is used also in the liquid crystal manufacturing installation.

[0003] The ceramics is used for equipment members, such as these heaters, an electrostatic chuck, and a susceptor for RF impression, as construction material excellent in corrosion resistance, abrasion resistance, precision, etc. The alumimium nitride ceramics is especially used abundantly from viewpoints, like the corrosion resistance over the halogen system gas used also in this in a mechanical strength, a degree of hardness, semiconductor fabrication machines and equipment, etc. is excellent. Moreover, generally as for the structure of said heater etc., the metal electrode is built in the ceramic substrate.

[0004] These members with a built-in electrode made from the ceramics are usually obtained by the manufacture approach shown below. In addition, as mentioned above, it is that, as for a heater, an electrostatic chuck, and the susceptor for RF impression, an operation and configuration of a metal electrode are only different, and each structure and the manufacture approach are fundamentally the same. Therefore, a heater is explained as an example below.

[0005] For example, in the sheet forming method, a metal electrode is first prepared with a doctor blade on the green sheet of the ceramics which carried out the laminating to predetermined thickness, and the laminating of the heater covering section of the ceramics of predetermined thickness is carried out with heat shaping on it. And after preparing an electrode terminal in the obtained layered product so that it may connect with a metal electrode, and degreasing on condition that predetermined, it is made to sinter at predetermined temperature with a hotpress etc., and a heater is obtained. In addition, in this sheet forming method, screen-stencil of a conductive paste is common as an approach of preparing a metal electrode on a green sheet.

[0006] moreover, the method of obtaining a heater as shown in drawing 2 (a) and (b) as other manufacture approaches of a heater -- it is -- press forming of the ceramics -- after making the coiled form metal electrode 12 lay under the inside of the body and forming the hole 13 for electrode terminals in it, there is the approach of making it build in the ceramic substrate 11 by making it sinter with a

hotpress.

[0007]

[Problem(s) to be Solved by the Invention] However, formation of the metal electrode by the above-mentioned screen-stencil must repeat the layer of the thin conductive paste of thickness, and must print it in piles. Therefore, it was what it is required and also takes time amount to a routing that printing-position doubling is highly precise whenever it performs copy printing. Moreover, when the thickness printed became an ununiformity, control of the total resistance of a metal electrode became difficult, and since it became uneven [resistance of each part of a metal electrode], also when breakage of this metal electrode or breakage of a ceramic substrate arose, it was by local abnormality generation of heat of a metal electrode.

[0008] Moreover, since the heater using the coiled form metal electrode 12 as shown in drawing 2 (a) and (b) has the large surface area of a heating element, equalization of whenever [field internal temperature / of a heater covering front face] can be attained. However, since the coil diameter of a metal electrode 12 became large, such a heater was what causes the technical problem that it will be necessary to enlarge thickness of a ceramic substrate, consequently heat capacity will increase, and the responsibility at the time of temperature control will fall.

[0009] It is made in order that this invention may solve the above technical technical problems. The endurance of the member with a built-in electrode made from the ceramics used in semiconductor fabrication machines and equipment, a liquid crystal manufacturing installation, etc. is raised. The heater which can heat a wafer, a liquid crystal display substrate, etc. to homogeneity with electric heat especially, an electrostatic chuck fixable by uniform adsorption power electrostatic, Or it aims at offering members with a built-in electrode made from the alumimium nitride ceramics, such as a susceptor for RF impression which can make a RF impress to homogeneity.

[0010]

[Means for Solving the Problem] The member with a built-in electrode made from the alumimium nitride ceramics concerning this invention is a member which built in the metal electrode, and the aspect ratio of the cross section of said metal electrode is characterized by or more 2 being eight or less. If this aspect ratio is above-mentioned within the limits, since it can maintain the firm adhesion between an alumimium nitride ceramic substrate and a metal electrode and the current resistance in each part of a metal electrode can be maintained to homogeneity, the member with a built-in electrode made from the alumimium nitride ceramics of high endurance can be obtained.

[0011] As for said metal electrode, it is desirable that it is what uses a tungsten as a principal component. It takes into consideration that it is close to the value of the coefficient of thermal expansion of the alumimium nitride ceramics which is a substrate etc.

[0012] Moreover, in this invention, it is desirable that the major-axis shaft of the cross section of said metal electrode is parallel to a ceramic substrate front face. Heater heating etc. can be made to act on homogeneity to the wafer laid in a ceramic substrate front face by building in a metal electrode, where flat is carried out to a ceramic substrate. Moreover, compared with the case where the coiled form conventional electrode is built in, a member with a built-in electrode made from the ceramics can be made into a thin shape.

[0013] Furthermore, as for said metal electrode, it is desirable to be covered in the condition that there is no opening, by the alumimium nitride ceramic substrate. It is because the current resistance in each part of a metal electrode tends to become an ununiformity and the endurance of a member with a built-in electrode made from the alumimium nitride ceramics will fall, when an opening is between a metal electrode and an alumimium nitride ceramic substrate.

[0014] The wrap alumimium nitride ceramics is said metal electrode further again Consistency 3.1 g/cm³ It is desirable that they are the above, less than [coefficient-of-thermal-expansion 6.0x10⁻⁶/degree C], and 50 or more W/m-K of thermal conductivity. By using the alumimium nitride ceramics applicable to the above-mentioned physical-properties value, heater heating in a ceramic substrate etc. can be acted on homogeneity, and the member with a built-in electrode made from the alumimium nitride ceramics of high endurance can be obtained.

[0015] As for the member with a built-in electrode made from the alumimum nitride ceramics concerning this invention, it is desirable to be used in order to make said metal electrode act as a resistance heating element, in order to generate static electricity by impressing a direct current or alternating current to said metal electrode, or in order to impress a RF with said metal electrode. These are applications with the suitable member with a built-in electrode made from the alumimum nitride ceramics concerning this invention.

[0016]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained more to a detail based on an accompanying drawing. Drawing 1 (a) and (b) show an example of the structure of the heater which is a member with a built-in electrode made from the alumimum nitride ceramics concerning this invention.

[0017] As for the heater made from the alumimum nitride ceramics shown in drawing 1 (a) and (b), the metal electrode 2 is built in the alumimum nitride ceramic substrate 1. And in the ceramic substrate side used as the heater base, from the hole 3 for electrode terminals, the electrode terminal is connected to the metal electrode 2, and it has the structure where a current is supplied from the exterior through this electrode terminal.

[0018] In the above, although the heater was explained, fundamentally, an electrostatic chuck and the susceptor for RF impression also consist of the same structure as the above as a member with a built-in electrode made from the alumimum nitride ceramics. Therefore, since members other than a heater are also obtained by the same manufacture approach, the member with a built-in electrode made from the alumimum nitride ceramics concerning this invention explains the concrete manufacture approach, concrete configuration, etc. below by making the heater made from the alumimum nitride ceramics into an example.

[0019] Although the heater made from the alumimum nitride ceramics concerning this invention is obtained by using the manufacture approach of the usual heater made from the ceramics, its following manufacture approaches are desirable, for example. The manufacture approach of the heater made from the alumimum nitride ceramics shown in drawing 1 processes the slot for forming a metal electrode 2 into the alumimum nitride ceramic substrate 1 used as heater covering first according to the electrode pattern configuration. And after forming a metal electrode 2 in that slot, the laminating of the alumimum nitride ceramic substrate used as this heater covering and the heater base is carried out with cement. Subsequently, the electrode terminal for supplying a current to the hole 3 for electrode terminals beforehand prepared in the heater base from the exterior is connected to a metal electrode 2. And the heater made from the alumimum nitride ceramics is obtained by performing junction heat treatment to the layered product of the alumimum nitride ceramic substrate 1 with which this metal electrode 2 was built in.

[0020] As a metal electrode 2 used in this invention, a metal wire is heated with a flame burner and what bent in the predetermined configuration and processed it, and the thing beforehand processed into the metal-electrode pattern configuration like the thin film obtained when laser processing or punching processing carried out a metallic thin plate, and a mesh are used. In this case, whenever [adhesion / to a slot / and restoration] can be raised by using a conductive paste together.

[0021] Moreover, it is made for the aspect ratio of the cross section, i.e., the ratio of the die length of a major axis and a minor axis, (L/H) to become eight or less [2 or more] in the condition of having been built in the alumimum nitride ceramic substrate 1, as said metal electrode 2 is shown in drawing 1 (c). When said aspect ratio is less than two, an opening may be generated between the alumimum nitride ceramic substrate 1 and a metal electrode 2. On the other hand, when said aspect ratio exceeds 8, it will become easy to damage a metal electrode 2, and a heater will be damaged by local abnormality generation of heat, and the endurance of a heater will fall.

[0022] Next, the thing of construction material which has the resistance as a heating element and has the melting point higher than desired exoergic temperature as construction material of a metal electrode 2 is desirable. Furthermore, as for the construction material of a metal electrode 2, it is especially desirable that it is close to the value of the coefficient of thermal expansion of the alumimum nitride ceramics

which is a substrate. In the busy condition of a heater, it is because stress arises in the interface and the alumimium nitride ceramic substrate 1 may be damaged, if the difference of the coefficient of thermal expansion of a metal electrode 2 and the alumimium nitride ceramic substrate 1 is large, since it expands by heating the alumimium nitride ceramic substrate 1 with a metal electrode 2.

[0023] Therefore, as construction material of a metal electrode 2, compounds containing them, such as a tungsten (W), molybdenum (Mo), platinum (Pt), and silver (Ag), can be used, for example. When it takes into consideration also in this that it is close to the value of the coefficient of thermal expansion of the junction heat treatment temperature exceeding 1500 degrees C, and the alumimium nitride ceramics etc., what uses a tungsten as a principal component especially is desirable.

[0024] Although an ellipse, a capsule form, a rectangle, etc. are not limited, the aspect ratio of the cross section is eight or less [2 or more] as mentioned above, and, as for especially the cross-section configuration of a metal electrode 2, it is desirable that the major-axis shaft is parallel to the front face of the alumimium nitride ceramic substrate 1. For example, although the cross-section configuration showed the ellipse-like metal electrode 2 to drawing 1 (c), it is desirable that the shaft orientations of this major axis (L) are parallel to the front face of the alumimium nitride ceramic substrate 1. As shown in drawing 1 (b), the wafer laid in the front face of the alumimium nitride ceramic substrate 1 can be heated to homogeneity by building in a metal electrode 2, where flat is carried out to the alumimium nitride ceramic substrate 1. Moreover, compared with the case where the coiled form conventional metal electrode 12 as shown in drawing 2 (b) is built in, a member with a built-in electrode made from the ceramics can be made into a thin shape. metal

[0025] Moreover, as for said metal electrode 2, it is desirable to be covered in the condition that there is no opening, by the alumimium nitride ceramic substrate 1. If there is an opening, the gas which exists in the part expands with heating of a heater, and with the stress, a crack will arise in the alumimium nitride ceramic substrate 1, or it will become the cause which a metal electrode 2 damages. Or the gas reacts chemically and it becomes the cause that stress arises, and a crack arises in the alumimium nitride ceramic substrate 1, may damage to it, and the endurance of a heater falls to the interior of a heater by the differential thermal expansion of a reactant and an unreacted object again.

[0026] The alumimium nitride ceramics used in this invention is 3 the consistency of 3.1g/cm. It is desirable that it is above. For a certain reason, the heater made from the alumimium nitride ceramics needs to have the high resistance over the fluorine system plasma, also when used under the fluorine system plasma. Although the alumimium nitride ceramics is an ingredient with the high resistance over the fluorine system plasma also in the ceramics, when a consistency is low, specific surface area becomes large, its amount of generation of the reactant in a front face increases, and it causes particle generating. Moreover, when a consistency is low, the fluorine system plasma passes the alumimium nitride ceramics, and touches a metal electrode 2, this metal electrode 2 corrodes, and it also becomes the cause of a short circuit. Therefore, the alumimium nitride ceramics is consistency 3.1 g/cm³. It is desirable that it is above and it is 3.2 g/cm³. It is more desirable that it is above.

[0027] Moreover, as for the coefficient of thermal expansion of the alumimium nitride ceramics, it is desirable that it is less than [6.0×10^{-6} /degree C]. As mentioned above, as for the coefficient of thermal expansion of the viewpoint which prevents breakage of the alumimium nitride ceramic substrate 1 to the alumimium nitride ceramics, and the tungsten used as a metal electrode 2, it is desirable that it is a near value. Therefore, as for the alumimium nitride ceramics, it is desirable that it is less than [coefficient-of-thermal-expansion 6.0×10^{-6} /degree C], and it is more desirable that it is less than [more than 3.8×10^{-6} /degree-C 5.5×10^{-6} /degree C].

[0028] Furthermore, as for the thermal conductivity of the alumimium nitride ceramics, it is desirable that they are 50 or more W/m-K. A heater will damage the temperature responsibility of the heater made from the ceramics by the differential thermal expansion of the alumimium nitride ceramic substrate 1 which a discrepancy becomes large whenever [in a heater covering front face / field internal temperature], and originates in the temperature range also depending on the heat conductivity of the ceramics depending on the case in addition to heat capacity when the heat conductivity is low. Therefore, as for the alumimium nitride ceramics, it is desirable that they are 50 or more W/m-K of

thermal conductivity, and it is more desirable that they are 90 or more W/m-K.

[0029] Next, recessing processes the slot doubled with the pattern configuration of a metal electrode 2 on the field with machining, sandblasting, etc., after carrying out surface grinding of the alumimium nitride ceramic substrate used as heater covering. A metal electrode 2 deforms the cross section of a slot with the pressure at the time of junction, and it is necessary to make it fit in the part. That is, it is desirable the cross section of heating element wiring, the same, or that make it small a little, and a metal electrode 2 is compressed and laid underground. Here, after carrying out surface grinding, the hole 3 for incorporating an electrode terminal is processed and formed in the alumimium nitride ceramic substrate used as the heater base at the after process.

[0030] And the laminating of the heater base and the heater covering is carried out through cement. Although said cement is good at the ceramic cement with which the general glass component is contained, since it is put to the fluorine system plasma, the heater used in semiconductor fabrication machines and equipment etc. has desirable cement which has the resistance over the fluorine system plasma. For example, it is desirable to use the compound of aluminum or/and an yttrium system.

[0031] Cement is applied on a substrate by pasting, screen-stenciling, or distributing organic solvents, such as alcohol, and carrying out spray spraying. And it degreases on the conditions usually performed if needed. In order to make bonding strength into sufficient thing, heating above 400 degrees C is common. Subsequently, an electrode terminal required for the hole 3 for electrode terminals in which the heater base where this cement was applied, and heater covering were beforehand prepared at superposition and the heater base etc. is incorporated.

[0032] Junction is performed by heat-treating the alumimium nitride ceramic substrate 1 by which the laminating was carried out through cement. In order to make bonding strength high, it is desirable, for example, a hotpress is used, from the exterior, heat-treating under a pressure puts a pressure and it heat-treats. In addition, in junction by the hotpress, it is based also on heat treatment temperature and a pressure, but it can also be made to join without necessarily needing cement.

[0033] Moreover, a hotpress is an effective means also in order to make junction and coincidence fill up with a metal electrode 2 that there is no opening in a slot. In this case, a pressure is usually 50kg/cm², although based on the path of heating element wiring, die length, etc. It is 500kg/cm² above. It carries out below. This pressure is 10kg/cm². In the following, since the metal electrodes 2, such as a metal wire, a thin film, and a mesh, do not fully deform, an opening is generated between slots. On the other hand, a pressure is 500kg/cm². When it exceeds, there is a possibility that a ceramic substrate may be damaged.

[0034] As for heat treatment temperature, it is desirable that it is [1400 degrees-C or more] 1950 degrees C or less. Grain growth of cement cannot take place that processing temperature is less than 1400 degrees C easily, and a good junction condition cannot be acquired. Moreover, since a metal electrode 2 does not fully deform, an opening is generated between slots. On the other hand, if processing temperature exceeds 1950 degrees C, cement will carry out abnormality grain growth and the nonconformity of being unable to obtain uniform bonding strength will arise. Therefore, as for heat treatment temperature, it is desirable that it is [1400 degrees-C or more] 1950 degrees C or less, and it is more desirable that it is [1600 degrees-C or more] 1800 degrees C or less.

[0035] In addition, in the above-mentioned operation gestalt, although the heater made from the alumimium nitride ceramics was explained as an example, if a metal electrode 2 is formed for example, in the shape of a sinking comb, the electrostatic chuck made from the alumimium nitride ceramics can be obtained.

[0036] Therefore, the member with a built-in electrode made from the alumimium nitride ceramics concerning this invention obtained as mentioned above can be suitably used in order to make said metal electrode act as a resistance heating element, in order to generate static electricity by impressing a direct current or alternating current to said metal electrode, or in order to impress a RF with said metal electrode.

[0037]

[Example] Hereafter, this invention is not restricted by the following example although this invention is

explained still more concretely based on an example.

After giving surface grinding to the alumimum nitride ceramics (Y₂O₃ is added 1 % of the weight of rates of outside as an assistant) with a diameter [of 210mm], and a thickness of 5mm used as [example 1] heater covering, according to the configuration of the circuit pattern of a metal electrode, the slot with a width of face [of 1.1mm] and a depth of 150 micrometers was formed in it by machining processing. The tungsten wire with a diameter of 0.5mm which processed the configuration of the circuit pattern of a metal electrode was inserted in this slot, and it fixed to it. After giving surface grinding to the alumimum nitride ceramics (Y₂O₃ is added 1 % of the weight of rates of outside as an assistant) with a diameter [of 210mm], and a thickness of 5mm used as the heater base, the cement paste of AlN/Y₂O₃/Li₂O=100/10/1 was applied by screen-stencil so that the thickness after cleaning might be set to 30 micrometers, and was made to degrease at 600 degrees C in atmospheric air for 1 hour. Said heater covering and said heater base were performed by superposition and application-of-pressure 0.1 t/cm², and the hotpress performed junction heat treatment at 1800 degrees C under nitrogen-gas-atmosphere mind for 3 hours. Then, the grinding process of the heater covering front face was carried out until it became the flatness of 10 micrometers, and the heater made from the alumimum nitride ceramics as shown in drawing 1 (a) and (b) was obtained. The produced heater was heated at 600 degrees C under reduced pressure of 0.01 torr(s), and the discrepancy was measured whenever [field internal temperature / of a heater covering front face]. Moreover, this heater was cut in the thickness direction and it asked for the aspect ratio of a wolfram electrode cross section. These measurement results are shown in a table 1.

[0038] They are the application-of-pressure conditions in the [example 1 of comparison] application-of-pressure heat treatment 0.04 t/cm² The heater made from the alumimum nitride ceramics was produced like the example 1 except carrying out. The produced heater was heated at 600 degrees C under reduced pressure of 0.01 torr like the example 1, and the discrepancy was measured whenever [field internal temperature / of a heater covering front face]. Moreover, it asked for the aspect ratio of a wolfram electrode cross section as well as an example 1. These measurement results are shown in a table 1. An opening is accepted between a wolfram electrode and an alumimum nitride ceramic substrate, it damaged and this heater stopped in addition, operating as a heater 20 hours after heater heating initiation.

[0039] They are the application-of-pressure conditions in the [example 2 of comparison] application-of-pressure heat treatment 0.6 t/cm² The heater made from the alumimum nitride ceramics was produced like the example 1 except carrying out. The produced heater was heated at 600 degrees C under reduced pressure of 0.01 torr like the example 1, and the discrepancy was measured whenever [field internal temperature / of a heater covering front face]. Moreover, it asked for the aspect ratio of a wolfram electrode cross section as well as an example 1. These measurement results are shown in a table 1. Local abnormality generation of heat is accepted, it damaged and this heater stopped in addition, operating as a heater 4 hours after heater heating initiation.

[0040]

[A table 1]

	加圧条件 (t/cm ²)	面内温度較差 (°C)	アスペクト比
実施例 1	0.1	5	6.60
比較例 1	0.04	20	1.85
比較例 2	0.6	38	9.24

[0041] As shown in a table 1, it was admitted that the heater of an example 1 had [whenever / field internal temperature] a small discrepancy compared with the example 2 of a comparison for which the example 1 of a comparison and aspect ratio whose aspect ratio the aspect ratio of the cross section of a wolfram electrode is 6.60, and is less than two exceed 8. Moreover, when the heater of an example 1 observed the cross section, there is no opening between a wolfram electrode and an alumimum nitride ceramic substrate, and both had stuck. On the other hand, as for the heater of the example 1 of a

comparison, the opening was accepted between the wolfram electrode and the alumimium nitride substrate as mentioned above. Moreover, although the heater of the example 2 of a comparison does not have an opening between a wolfram electrode and an alumimium nitride ceramic substrate and both had stuck, the aspect ratio was as large as 9.24, flat [of the wolfram electrode] was carried out and its spacing of electrode wiring within a field was also uneven. Although, as for the heater of an example 1, 1000 hours after actuation initiation was operating not changeful when operating a heater, it damaged 20 hours after and the heater of the example 1 of a comparison stopped furthermore, operating as a heater. After the heater of the example 2 of a comparison produced local abnormality generation of heat, it damaged 4 hours after and it stopped moreover, operating as a heater.

[0042] This shows that a heater covering front face can be heated to homogeneity, without the heater made from the alumimium nitride ceramics whose aspect ratio of the cross section of a wolfram electrode is eight or less [2 or more] producing abnormality generation of heat.

[0043]

[Effect of the Invention] As mentioned above, compared with the conventional thing, control of electric resistance etc. becomes easy and the member with a built-in electrode made from the alumimium nitride ceramics concerning this invention becomes possible [thin-shape-izing]. Furthermore, improvement in endurance can also be aimed at. Furthermore, by using the member with a built-in electrode made from the alumimium nitride ceramics concerning this invention, in semiconductor fabrication machines and equipment, a liquid crystal manufacturing installation, etc., heating or adsorption power, and an impression electromagnetic wave can be made uniform, and a wafer, a liquid crystal display substrate, etc. aim at improvement in the yield of a semi-conductor or liquid crystal manufacture, and can carry out the thing of it in the case of processing.

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CLAIMS

[Claim(s)]

[Claim 1] The member with a built-in electrode made from the alumimium nitride ceramics to which it is the member which built in the metal electrode, and the aspect ratio of the cross section of said metal electrode is characterized by or more 2 being eight or less.

[Claim 2] Said metal electrode is a member according to claim 1 with a built-in electrode made from the alumimium nitride ceramics characterized by being what uses a tungsten as a principal component.

[Claim 3] The member according to claim 1 or 2 with a built-in electrode made from the alumimium nitride ceramics to which the major-axis shaft of the cross section of said metal electrode is characterized by being parallel to an alumimium nitride ceramic substrate front face.

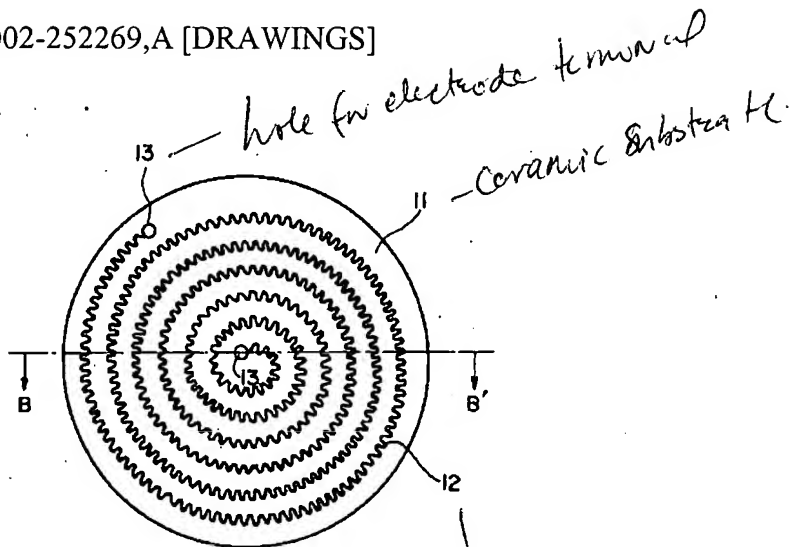
[Claim 4] Said metal electrode is a member given in either from claim 1 characterized by being covered in the condition that there is no opening, by the alumimium nitride ceramic substrate to claim 3 with a built-in electrode made from the alumimium nitride ceramics.

[Claim 5] A wrap alumimium nitride ceramic substrate is said metal electrode Consistency 3.1 g/cm³ The above, less than [coefficient-of-thermal-expansion 6.0×10^{-6} /degree C], and member given in either from claim 1 characterized by being 50 or more W/m-K of thermal conductivity to claim 4 with a built-in electrode made from the alumimium nitride ceramics.

[Claim 6] A member given in either from claim 1 characterized by being used in order to make said metal electrode act as a resistance heating element, in order to generate static electricity by impressing a direct current or alternating current to said metal electrode, or in order to impress a RF with said metal electrode to claim 5 with a built-in electrode made from the alumimium nitride ceramics.

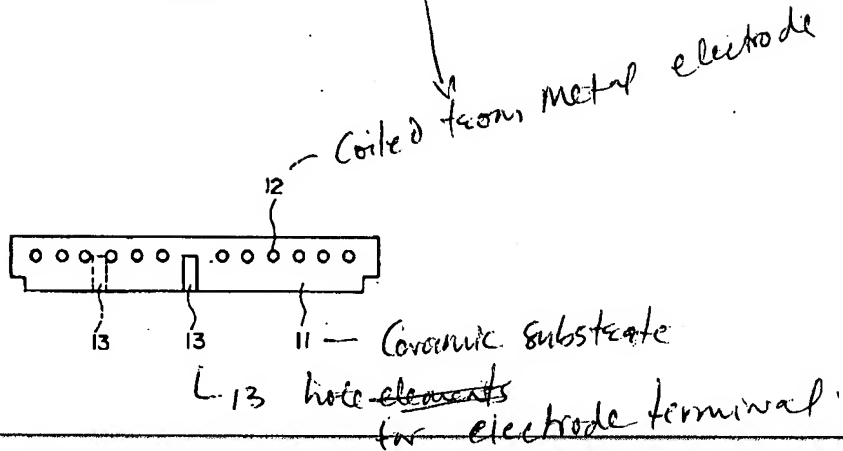
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(a)




DRAWING 2.

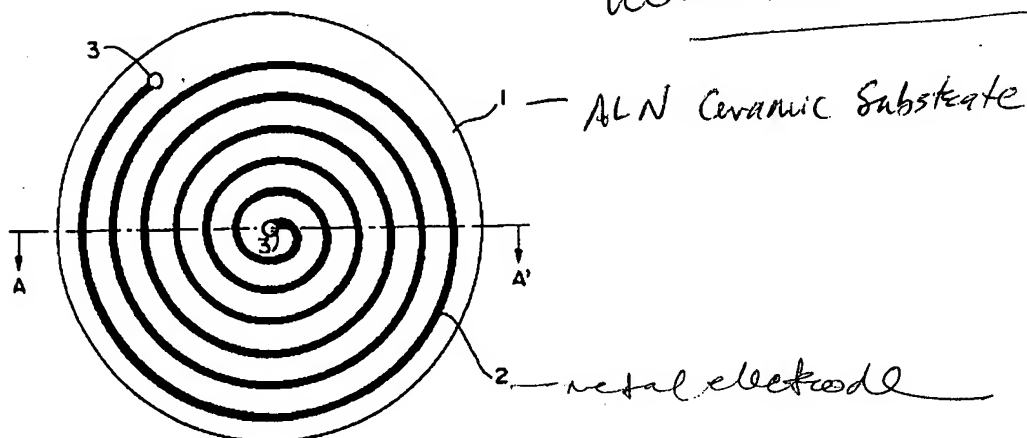
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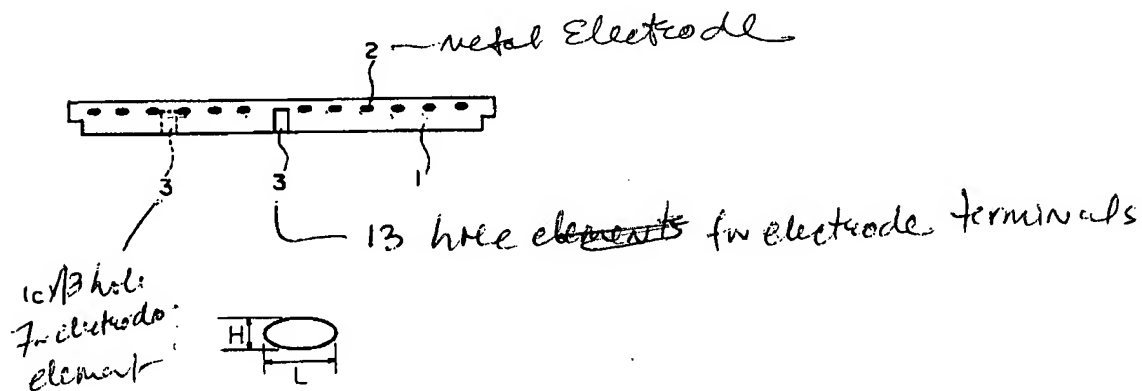
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Drawing selection drawing 1 

(a)

Heater made from the ALN Ceramic

(b)



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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] (a) It is the perspective drawing from a top face having shown typically an example of the heater made from the alumimium nitride ceramics concerning this invention.

(b) It is the A-A' sectional view of drawing 1 (a).

(c) It is the enlarged drawing of the metal electrode shown in drawing 1 (b).

[Drawing 2] (b) It is the perspective drawing from a top face having shown an example of the conventional heater made from the ceramics typically.

(b) It is the B-B' sectional view of drawing 2 (a).

[Description of Notations]

1 Alumimium Nitride Ceramic Substrate

2 Metal Electrode

3 13 Hole for electrode terminals

11 Ceramic Substrate

12 Coiled Form Metal Electrode

[Translation done.]